IN THE SPECIFICATION:

Please amend paragraph number **[0001]** as follows:

[0001] This application is a divisional of application Serial No. 09/712,473, filed November 14, 2000, ~~pending~~now U.S. Patent No. 6,719,070, issued April 13, 2004.

Please amend paragraph number **[0003]** as follows:

[0003] State of the Art: Formation coring is a well-known process in the oil and gas industry. In conventional coring operations, a core barrel assembly is used to cut a cylindrical core from the subterranean formation and to transport the core to the surface for analysis. Analysis of the core can reveal invaluable data concerning subsurface geological formations and, particularly, hydrocarbon-bearing ~~formations~~ formations, including parameters such as permeability, porosity, and fluid ~~saturation~~ saturation, ~~that~~ which are useful in the exploration for petroleum, gas, and minerals. Such data may also be useful for construction site evaluation and in quarrying operations.

Please amend paragraph number **[0008]** as follows:

[0008] Located within the outer barrel assembly, and releasably attached to the swivel assembly, is the inner barrel assembly. The inner barrel assembly includes an inner tube configured for retaining the core and a core shoe disposed at one end thereof adjacent the throat of the core bit. The core shoe is configured to receive the core as it enters the throat and to guide the core into the inner tube. A core catcher may be disposed proximate the core shoe to assist, in conjunction with the core shoe, in guiding the core into the inner tube and also to retain the core within the inner tube. Thus, as the core is ~~cut~~ cut — by application of weight to the core bit through the outer barrel assembly and drill string in conjunction with rotation of these ~~components~~ components — the core will traverse the throat of the core bit to eventually reach the rotationally stationary core shoe, which accepts the core and guides it into the inner tube where the core is retained until transported to the surface for examination.

Please amend paragraph number **[0010]** as follows:

[0010] The discharge of drilling fluid from the port outlets at the face surface of a core bit during a coring operation may result in drilling fluid invasion of the core. Drilling fluid invasion may result from any one of a number of conditions, or a combination thereof. Drilling fluid discharged at the face surface of the core bit may, if not appropriately directed radially outward away from the core, flow towards the core being cut where the drilling fluid can then contact the core. Also, in most conventional core bits, a narrow annulus exists in a region bounded by the inside diameter of the bit body and the outside diameter of the core shoe, this narrow annulus essentially being an extension of the annular region and terminating at an annular gap proximate the entrance to the core shoe near the throat of the core bit. Pressurized drilling fluid circulating in the annular region may, in addition to flowing into the port inlets, flow into the narrow annulus and out through the annular gap to be discharged proximate the throat of the core bit. This drilling fluid entering the narrow annulus and exiting the annular gap proximate the throat of the core~~ bit~~ bit, referred to as "flow~~ split"~~ split," can contact the core being cut as the core traverses the throat and enters the core shoe. Further, a low rate of penetration ("ROP") through the formation being cored can lead to drilling fluid invasion of the core as the exposure time of the core to drilling fluids is unduly prolonged.

Please amend paragraph number **[0012]** as follows:

[0012] Another significant factor that may inhibit the acquisition of reliable formation fluid saturation data is reservoir gas expansion resulting from a large pressure differential between the bottom of the bore hole and the surface. As a core sample is raised to the surface from the bottom of the bore~~ hole~~ hole, where the pressure may be relatively~~ high~~ high, gases entrained within the core sample will expand and migrate out of the core sample. The expansion and migration of reservoir gases from the core sample often cause reservoir fluids contained within the core sample to be expelled. The expelled reservoir fluids are difficult, if not impossible, to recover and, therefore, the reliable measurement of fluid saturation properties is impeded.

Please amend paragraph number **[0018]** as follows:

[0018] Sponge liners are typically supplied in standard ~~5 ft~~ 5-ft or ~~6 ft~~ 6-ft sections, a number of which are placed end-to-end within the inner tube to substantially fill the ~~length – usually~~ length, (usually a standard ~~30 ft –~~ 30 feet) of the inner tube. The inner tube is typically constructed of a steel material and, as indicated above, the tubular sleeve of a conventional sponge liner comprises an aluminum material. Due to the differences in material properties of the tubular sleeve and the inner ~~tube –~~ tube, the coefficient of thermal expansion for aluminum is approximately twice that of ~~steel –~~ steel, and the long extent of the inner tube and sponge liners disposed end-to-end therein, the conventional sponge core barrel assembly routinely experiences differential thermal expansion. Differential thermal expansion between the inner tube and sponge liners may occur longitudinally along the length of the inner tube as well as radially. Differential thermal expansion may cause mechanical damage to components of the sponge core barrel assembly and may also damage the core sample.

Please amend paragraph number **[0020]** as follows:

[0020] As noted above, flow split is the result of the flow of drilling fluid from the annular region between the inner and outer barrel assemblies and through a narrow annulus that exists between the bit body and the core shoe, to be exhausted through an annular gap near the throat of the core bit and proximate the core sample. The annular gap is defined by a longitudinal distance between the lower end of the core shoe and the bit body. The width of the annular ~~gap –~~ gap — and, hence, the volume of flow ~~split –~~ split — is a function of the difference between the longitudinal length of the outer barrel assembly and the longitudinal length of the inner barrel ~~assembly,~~ assembly; the inner barrel assembly being suspended at its upper end from a swivel assembly disposed proximate the upper end of the outer barrel assembly. Although the provision of a narrow annulus and annular gap may result in flow split, the narrow annulus and annular gap are necessary as the clearance between the core shoe and the bit body provided by the narrow annulus and annular gap enables the outer barrel assembly and core bit to rotate freely relative to the inner barrel assembly. Thus, it is desirable to maintain the width of the annular gap at a controlled, minimum distance.

Please amend paragraph number **[0022]** as follows:

[0022] In conventional sponge coring operations, in order to protect the sponge liners from drilling fluid contamination prior to commencement of coring and from being compressed as a result of high downhole pressure, the inner tube is evacuated and filled with a presaturation fluid. The presaturation fluid is selected such that it will not be absorbed by the annular sponge ~~layer -~~ layer, i.e., the presaturation fluid comprises a base fluid that exhibits characteristics opposite to those of the reservoir fluid being measured. For example, if oil saturation data is required, the presaturation fluid may include water as the base fluid. Presaturation usually occurs on the floor of the drilling rig after an inner barrel is assembled. A valve disposed at the upper end of the inner tube enables the evacuation of the inner tube and the subsequent pumping of presaturation fluid into the inner tube.

Please amend paragraph number **[0026]** as follows:

[0026] As suggested above, a conventional assembled sponge core barrel comprises a standard ~~30 ft~~ 30-ft outer barrel assembly having a core bit secured to a lower end thereof. Disposed within the outer barrel assembly, and rotationally suspended from a swivel assembly, is a standard ~~30 ft~~ 30-ft inner barrel assembly. The inner barrel assembly includes an inner tube with a plurality of ~~5 ft~~ 5-ft or ~~6 ft~~ 6-ft sponge liners disposed end-to-end therein. The inner barrel is assembled on the drilling rig floor and is subsequently evacuated and filled with presaturation fluid prior to being picked up and lowered into the outer barrel assembly, which is suspended from the rig floor. Use of a ~~30 ft~~ 30-ft sponge core barrel assembly, however, inherently limits the efficiency of sponge coring operations. The sponge core barrel assembly must be raised from the bore hole when the maximum length of core has been retrieved inside the inner barrel, such that the core sample can be removed from the inner barrel assembly and new sponge liners inserted. Raising, or tripping, of a drill string from the bore hole is a time-consuming operation and, therefore, it is desirable to core with core barrels greater than 30 ~~ft~~ feet in length.

Please amend paragraph number **[0027]** as follows:

[0027] Conventional coring ~~operations -~~ operations — not including conventional

sponge~~coring~~ coring — are routinely performed using core barrel lengths of~~60 ft, 90 ft, 120 ft,~~ 60 feet, 90 feet, 120 feet, or longer. Make up of the outer barrel assembly typically comprises interconnecting the various components of the outer barrel assembly while suspending the outer barrel through the floor of the drilling rig. In other words, each component of the outer barrel assembly is~~individually~~ individually or, in conjunction with other attached~~components~~ components, lifted off the rig floor and secured to the partially assembled outer barrel (i.e., those components already assembled), which is suspended from the rig floor. Subsequently, the inner barrel assembly is rigged up section-by-section within the outer barrel assembly, interconnections between the inner barrel sections being made just above the upper end of the outer barrel assembly. The inner barrel assembly is then secured to a swivel assembly that is attached to the outer barrel assembly, the swivel assembly rotationally isolating the inner barrel assembly from the outer barrel assembly.

Please amend paragraph number **[0028]** as follows:

[0028] By way of example, a~~90 ft~~ 90-ft outer barrel assembly having a core bit secured to a lower end thereof may be rigged up and suspended through the rig floor. A first~~30 ft~~ 30-ft section of inner barrel having a core shoe at a lower end thereof is then lowered into the outer barrel assembly, a portion of the upper end of the first inner barrel section extending above the outer barrel assembly. Next, a second~~30 ft~~ 30-ft section of inner barrel is lifted off the rig floor and a lower end thereof is connected to the upper end of the first inner barrel section, the first and second inner barrel sections then being lowered into the outer barrel assembly with a portion of the upper end of the second inner barrel section extending above the outer barrel assembly. A third~~30 ft~~ 30-ft section of inner barrel is then lifted off the rig floor and a lower end of this third section is connected to the upper end of the second inner barrel section. The first, second, and third interconnected inner barrel sections are then lowered into the outer barrel assembly. Additional components may be secured to the upper end of the third inner barrel section, such as a pressure relief plug and drop ball. The first, second, and third inner barrel~~sections~~ sections — the inner barrel~~assembly~~ assembly — is then secured to a swivel assembly that is attached to the outer barrel assembly. The upper end of the outer barrel assembly is subsequently secured to the lower end of a drill string for coring.

Please amend paragraph number **[0029]** as follows:

[0029] During make up of the inner barrel assembly, a section of inner ~~tube~~ tube, or two or more interconnected inner tube ~~sections~~ sections, may be stored in a mouse hole prior to being hoisted above the outer barrel assembly for assembly and insertion thereinto. A mouse hole is an opening extending through and below the rig floor into which one or more inner tube sections (as well as outer barrel components) may be temporarily placed for make up and subsequent transfer to the outer barrel assembly. Offshore drilling rigs commonly have a mouse hole extending to a depth of 60 feet or more below the rig floor.

Please amend paragraph number **[0030]** as follows:

[0030] It would be desirable to conduct sponge coring operations with a core barrel assembly greater than 30~~ ft~~ feet in~~ length~~ length, i.e., using a~~ 60 ft, 90 ft, 120 ft,~~ 60-ft, 90-ft, 120-ft, or other desired extended-length core barrel comprised of multiple~~ 30 ft~~ 30-ft (or some other suitable length) sections of inner~~ barrel~~ barrel, such as is routinely performed in conventional coring operations, as noted above. However, to present day, it has been thought impossible to conduct sponge coring operations with extended-length core~~ barrels~~ barrels, i.e., one having a length greater than 30~~ feet~~ feet, due to a number of technical difficulties. Specifically, frictional forces generated between a core and a sponge-lined inner barrel increase as a function of length of the sponge-lined inner barrel, and high frictional forces can adversely affect the mechanical integrity of the core, as well as cause damage to the sponge material. Thus, for sponge-lined inner barrels longer than the conventional 30 feet, it has been believed that, without significant improvements of the sponge material, extreme frictional forces would be generated between the sponge materials, such extreme frictional forces leading to core damage and structural failure of the sponge material. Also, differential thermal expansion and resultant problems, as noted above, become more pronounced with increasing length of the core barrel assembly. Further, suitable methods and apparatus for performing sponge coring with extended-length core barrels are presently unavailable. For example, methods and apparatus for separately presaturating and subsequently interconnecting individual sections of inner tube were heretofore unknown.

Please amend paragraph number **[0035]** as follows:

[0035] The sponge liners may be provided in conventional~~ 5 ft~~ 5-ft or~~ 6 ft~~ 6-ft lengths which are stacked end-to-end within the inner barrel assembly, or within each section of inner tube making up the inner barrel assembly. In another embodiment of the present invention, however, a sponge liner is provided in a length substantially equivalent to the length of the inner barrel assembly, or substantially equivalent in length to the length of each inner tube section making up a multi-section inner barrel assembly.

Please amend paragraph number **[0045]** as follows:

[0045] The first inner tube section may be made-up on the floor of a drilling rig, with the lower seal assembly providing a fluid seal at an upper end thereof and a piston assembly according to the invention (or, optionally, the upper seal assembly of another valve assembly) providing a fluid seal at a lower end thereof. The first inner tube section may then be individually filled with presaturation fluid, lifted off the floor of the drilling rig, and inserted into the outer barrel assembly, which is suspended through the rig floor. The second inner tube section may then be made-up on the rig floor, with the upper seal assembly providing a fluid seal at a lower end thereof and the pressure compensation mechanism (or, optionally, the lower seal assembly of yet another valve assembly) providing a fluid seal at an upper end thereof. The second inner tube section may then be individually filled with presaturation fluid, lifted off the rig floor, and connected to the first inner tube ~~section,~~ section; the first and second inner tube sections are then ~~being~~ further lowered into the outer barrel assembly. Interconnection of the first and second inner tube sections comprises securing the upper and lower seal assemblies to one another and opening the seal element of each seal assembly, thereby forming an inner barrel assembly having a single, continuous chamber filled with presaturation fluid. Any suitable number of inner tube sections and valve assemblies according to the invention may be used to fabricate an inner barrel assembly.

Please amend paragraph number **[0065]** as follows:

[0065] The inner barrel assembly 200 comprises a plurality of inner tube sections. The exemplary embodiments shown in FIGS. 1A-1C, 7, 8, 9, 10, 11, 12A-12C, and 13 each include three inner tube sections 210a, 210b, 210c; however, the present invention is not so limited and those of ordinary skill in the art will appreciate that the inner barrel assembly 200 may include any suitable number of inner barrel sections. Each inner ~~barrel~~ tube section 210a, 210b, 210c has a specified length, typically 30 ~~ft.~~ feet. The inner ~~barrel~~ tube sections 210a, 210b, 210c may, however, be of any suitable length, such as, for example, 45 ~~ft~~ feet or 60 ~~ft.~~ feet.

Please amend paragraph number **[0066]** as follows:

[0066] A core shoe 220 is secured to a lower end 212a of the lowermost inner tube section 210a. During coring, as the core sample 5 traverses the throat 320 of the core bit 300, the core shoe 220 functions to receive the core sample 5 and to guide the core sample 5 into the inner barrel assembly 200, where the core sample 5 is retained for subsequent transportation to the surface. A core catcher 230 may also be disposed proximate the lower end 212a of the lowermost inner tube section ~~210a,~~ 210a; the core catcher 230 also serving to guide the core sample 5 into the inner barrel assembly 200 and, further, functioning to retain the core sample 5 within the inner barrel assembly 200.

Please amend paragraph number **[0071]** as follows:

[0071] As noted above, debonding or peeling of the sponge material from the sleeve has been a concern with conventional sponge liners. According to the present invention, a robust, high-strength bond is provided between the annular sponge layer 241 and the sleeve 242 by one or more grooves 244 formed or machined into the interior wall 243 of the sleeve 242. The annular sponge layer 241 extends into the groove or grooves 244 to rigidly secure the annular sponge layer 241 to the sleeve 242. Extension of the annular sponge layer 241 into the groove or grooves 244 in sleeve 242 may be achieved by directly molding the annular sponge layer 241 into the sleeve 242. Alternatively, the annular sponge layer 241 may be separately fabricated and subsequently attached to the sleeve 242. Also, the annular sponge layer 241 may be further secured to the interior wall 243 of sleeve 242 using an adhesive bonding process. Other processes may be employed to increase the strength of the bond between the annular sponge layer 241 and the sleeve 242, such ~~as~~ as an ultrasonic welding process, depending upon the selection of materials for the annular sponge layer 241 and sleeve 242, respectively ~~an ultrasonic welding process~~.

Please amend paragraph number **[0073]** as follows:

[0073] Further structural strength may be imparted to the annular sponge layer 241 by a webbing layer 246. Webbing layer 246 comprises a webbing of any suitable pattern or configuration that is immersed ~~within~~ within — or molded ~~into~~ into — the annular sponge

layer 241. Although the webbing layer 246 is shown in FIGS. 2~~ and ~~-3 as being disposed proximate the interior surface 245 of the annular sponge layer 241, it should be understood that the webbing layer 246 may be disposed at any suitable location within the radial thickness of the annular sponge layer 241. The webbing layer 246 may comprise any suitable material known in the art, such as, by way of example, polyethylene filament or nylon filament, that does not interfere with the absorption of reservoir fluids by the annular sponge layer 241.

Please amend paragraph number **[0075]** as follows:

[0075] A sponge liner 240 may be of any suitable length. The sponge liners 240 may, for example, be provided in~~ 5 ft~~ 5-ft or~~ 6 ft~~ 6-ft lengths which are stacked end-to-end within each inner tube section 210a, 210b, 210c. If stacked end-to-end, the ends of each sponge liner 240 may be configured to provide an interlocking end-to-end connection between adjacent sponge liners 240, as will be explained in greater detail below. Although sponge liners are conventionally supplied in standard~~ 5 ft~~ 5-ft or~~ 6 ft~~ 6-ft lengths, it is within the scope of the present invention that a sponge liner 240 be provided in a length substantially equivalent to the length of the inner tube sections 210a, 210b, 210c. For example, the sponge liners 240 and inner tube sections 210a, 210b, 210c may be provided in~~ 30 ft~~ 30-ft lengths,~~ 45 ft~~ 45-ft lengths, or~~ 60 ft~~ 60-ft lengths, or any other suitable length as desired.

Please amend paragraph number **[0076]** as follows:

[0076] In an alternative embodiment of the present invention, the inner barrel assembly 200, rather than being comprised of inner tube sections 210a, 210b, 210c and separate sponge liner or liners 240, is comprised of one or more sponge-lined inner tube sections 210a, 210b, 210c, or integrated sponge barrels 280, as shown in FIG. 5. Each integrated sponge barrel 280 comprises an inner tube section 282 encasing an annular layer of sponge material 281. The inner tube section 282 may be constructed of any suitable material, including both ferrous and nonferrous metals as well as resin- or epoxy-based composite materials. The annular layer of sponge material 281 is secured to, or molded onto, the interior cylindrical surface 283 of the inner tube section 282. One or more grooves (not shown in FIG. 5) may be

formed or machined into the interior cylindrical surface 283 of the inner tube section 282 to secure the annular layer of sponge material 281 thereto, as shown and described with respect to FIGS. 2~~through~~-4. Also, as shown in FIG. 5, the integrated sponge barrel 280 may include a layer of webbing 286 immersed in, or molded into, the annular layer of sponge material 281.

Please amend paragraph number **[0077]** as follows:

[0077] Make up of an inner barrel assembly 200 according to this embodiment of the invention may include interconnecting one or more integrated sponge barrels 280, while insertion of separate sponge~~liners as~~ liners, (as well as shims, as described~~below~~ below) into an inner tube section is not required. Further, an integrated sponge barrel 280 has only a single outer material layer comprised of the inner tube section 282; the integrated sponge barrel 280 does not include a~~sleeve~~ sleeve 242 constructed from a first material surrounding the sponge material and encased within an inner tube constructed of a second, different material. Thus, use of one or more integrated sponge barrels 280 simplifies assembly of the inner barrel assembly 200 and eliminates differential thermal expansion between the inner tube sections and sponge liner or liners.

Please amend paragraph number **[0079]** as follows:

[0079] Referring to FIG. 6, a portion of a first sponge liner 240a is shown in an end-to-end relationship with a portion of a second sponge liner 240b. The end 290a of the first sponge liner 240a is in abutting contact with the end 290b of the~~second,~~ adjacent, second sponge liner 240b. ~~Sponge~~First sponge liner 240a comprises sleeve 242a, annular sponge layer 241a, and webbing layer 246a, while second sponge liner 240b comprises sleeve 242b, annular sponge layer 241b, and webbing layer 246b. End 290a of the first sponge liner 240a is formed to a contour 291a and end 290b of the second sponge liner 240b is formed to a mating contour 291b. The contours 291a, 291b are generally nontransverse to the longitudinal axis 12 of sponge core barrel assembly 10 and are substantially conformal to one another, such that the ends 290a, 290b of the first and second sponge liners 240a, 240b, respectively, closely mate to form an interlocking end-to-end connection between the first and second sponge liners 240a, 240b. The

contours 291a, 291b may be of any suitable configuration, such as, for example, a bevel as shown in FIG. 6, a generally parabolic contour, or a tongue-in-groove configuration.

Please amend paragraph number **[0080]** as follows:

[0080] The interlocking nature of the contours 291a, 291b on the ends 290a, 290b of the first and second sponge liners 240a, 240b, respectively, centers the first and second sponge liners 240a, 240b relative to one another and prevents the formation of a gap between the ends 290a, 290b thereof, such a gap potentially creating a collection point for debris or providing a surface or edge for snagging the leading end of the core. Thus, the interlocking end-to-end connection provided by the mating contours 291a, 291b between the abutting ends 290a, 290b of two adjacent first and second sponge liners 240a, 240b provides a smooth joint over which the core sample 5 can pass without damage.

Please amend paragraph number **[0081]** as follows:

[0081] Referring to FIG. 7, piston assembly 400 comprises a piston rod 420 comprising an outer cylindrical surface 421 slidably disposed within a bore 411 of a cylindrical piston 410, the piston 410 having an upper end 416 and a lower end 417. The piston 410 is seated within the lower end 212a of the lowermost inner tube section 210a. It should be noted that, although referred to herein as being part of the lowermost inner tube section 210a, the lower end 212a of the lowermost inner tube section 210a is often referred to as the upper core~~-shoe~~ shoe 220 and may be a separate tubular section attached by threads to the lowermost inner tube section 210a. However, the specific configuration of the inner barrel assembly~~-200-~~ 200 — and the particular terminology~~-employed-~~ employed — is immaterial to the present invention, and those of ordinary skill in the art will understand that the various aspects of the present invention are applicable to any core barrel configuration, regardless of the particular structure and the terminology used to describe such structure.

Please amend paragraph number **[0082]** as follows:

[0082] An O-ring type seal 470 is disposed within an annular groove 215 in the interior

wall of the lowermost inner tube section 210a, the O-ring type seal 470 providing a fluid seal between the lowermost inner tube section 210a and the outer cylindrical surface 412 of the piston 410. Any other suitable type of seal as known in the art may be used to provide the fluid seal between the lowermost inner tube section 210a and the piston 410. One or more locking elements 440 are disposed about the circumference of the piston 410. Each locking element 440 is configured to freely move within a passageway 413 extending radially through the piston 410. In its radially outermost position, as shown in FIG. 7, each locking element 440 is configured to engage an annular groove 217 in the wall of the lowermost inner tube section 210a. With the ends 442 of the locking elements 440 extending into the annular groove 217, the piston 410 is in the locked condition and the relative longitudinal position (along longitudinal axis 12 of the sponge core barrel assembly 10) of the piston 410 within the lowermost inner tube section 210a is fixed. Thus, in the locked condition, the outer cylindrical surface 412 of the piston 410 is able to interface with the O-ring type seal 470 disposed within annular groove 215 in the interior wall of lowermost inner tube section 210a, thereby providing the fluid seal between the piston 410 and lowermost inner tube section 210a.

Please amend paragraph number **[0083]** as follows:

[0083] The piston rod 420 comprises a longitudinally extending cylinder having a central bore 422 extending therethrough. The lower end of piston rod 420 comprises a disk portion 430. The disk portion 430 includes a lower, circular, planar surface 434, the bore 422 extending towards and opening onto the planar surface 434. One or more ports 432 extend radially through the disk portion 430 and are in fluid communication with the bore 422, the ports 432 extending generally transverse to the bore 422. Located proximate the upper end of the piston rod 420 are one or more radially extending ports ~~423,~~ 423; the ports 423 are also ~~being~~ in fluid communication with the bore 422 and extending generally transverse thereto.

Please amend paragraph number **[0086]** as follows:

[0086] The interface between the lower surface 451 of the retaining element 450 and the upper end 416 of the piston 410 is not intended to provide a fluid ~~seal—the~~ seal, the necessary

fluid seal being provided by the O-ring type seal ~~460~~ 460, and, therefore, the lower surface 451 of the retaining element 450 may be subjected to the pressurized presaturation fluid within chamber 216a (or chamber 205). The exposed area of lower surface 451 is reduced in comparison to the exposed area of upper surface 452 only to the extent that the center portion of lower surface 451 is not exposed to presaturation fluid. Thus, the force exerted on the lower surface 451 as a result of pressurized presaturation fluid may not be significantly less than the corresponding force exerted on the upper surface 452.

Please amend paragraph number **[0091]** as follows:

[0091] As the piston 410 begins to move longitudinally upward, a beveled surface 443 on the outer end 442 of each locking element 440 interfaces with a mating beveled surface 219 in the annular groove 217 in the wall of the lowermost inner tube section 210a. The beveled surface 219 functions as a cam surface (and the beveled surface 443 as a follower) to move the locking elements 440 radially inwardly. Although shown in FIG. 7 as generally planar beveled surfaces, the particular contours of the surfaces 219, 443 may be of any suitable configuration known in the art, so long as beveled surface 219 imparts a radially inward force on the locking element 440 as beveled surface 443 moves relative to beveled surface 219.

Please amend paragraph number **[0093]** as follows:

[0093] As noted above, when the piston rod 420 is fully compressed, the ports 423 proximate the upper end of the piston rod 420 are in fluid communication with the chamber 205 (or chamber 216a). Also, as noted previously, the port or ports 423 are in fluid communication with the bore 422 extending through the piston rod 420 and the bore 422 is in fluid communication with the port or ports 432 extending radially through the disk portion 430. Thus, the ports 423, bore 422, and ports 432 cooperatively provide a passageway extending through the piston assembly 400. This passageway provides a flow path for presaturation fluid retained within chamber 205 of inner barrel assembly 200 to discharge therefrom upon entry of the core sample 5 into the lowermost inner tube section 210a. The presaturation fluid will flow through the passageway around the core sample 5 and towards the throat 320 of core bit 300, where the

presaturation fluid is expelled into the bore hole.

Please amend paragraph number **[0095]** as follows:

[0095] In prior art piston-type sealing mechanisms, the piston was retained in the inner tube and the presaturation fluid contained within the inner tube, solely by frictional forces exerted on the piston. An O-ring in contact with the piston and the inner tube and providing a seal therebetween, as well as surfaces of the piston and inner tube in contact, provided the necessary frictional forces. In order to hold the piston in place against the forces exerted thereon by presaturation fluid held within the inner tube under pressure (in some instances, high pressure), these frictional forces are necessarily relatively high. Therefore, when the core contacts the piston, the core must apply a starting force on the piston large enough to overcome the static frictional forces exerted thereon and the forces exerted on the piston by the pressurized presaturation fluid. Once the piston has been moved a small distance, the seal provided by the O-ring will be broken and the presaturation fluid released, thereby lowering the force required to move the piston through the inner tube. Nonetheless, a large starting force is necessary to initiate movement of the piston and break the seal, and this large starting force may cause structural damage to the core ~~sample.~~ sample 5.

Please amend paragraph number **[0096]** as follows:

[0096] The piston assembly 400 according to the present invention, however, does not suffer from a significant weakness of the prior art (i.e., a large starting force to initiate movement of the piston). As indicated previously, the presaturation fluid is discharged ~~from--~~ from — or is at least beginning to flow out ~~of--~~ of — the chamber 205 within the inner barrel assembly 200 prior to any upward longitudinal movement of the piston 410. Thus, forces on the piston 410 resulting from the presaturation fluid pressure are substantially non-existent during translation of the piston 410. Also, because the piston 410 is positively locked into position by the locking elements 440, high frictional forces between the piston 410 and the interior wall of the lowermost inner tube section ~~210a--~~ 210a, ~~whether~~ (whether provided by an O-ring or resulting from contact between the piston 410 and lowermost inner tube section ~~210a--~~ 210a) are not necessary to

maintain the position of the piston 410 prior to contact with the core sample 5.

Please amend paragraph number **[0100]** as follows:

[0100] During coring, thermal expansion of the presaturation fluid as a result of high downhole temperature and compression of the core barrel assembly due to high downhole pressure may cause the presaturation fluid pressure within the chamber 205 to increase significantly. Whenever the presaturation fluid pressure within chamber 205 reaches the specified limit of the pressure relief element 520, however, the pressure relief element 520 will release a limited volume of presaturation fluid sufficient to lower the presaturation fluid pressure to within the specified limit. Thus, pressure compensation mechanism 500 provides a ~~mechanism–~~ mechanism — i.e., pressure relief element~~-520–~~ 520 — for continually compensating for changes in fluid pressure within the inner barrel assembly 200, regardless of the cause of the pressure increase.

Please amend paragraph number **[0103]** as follows:

[0103] The outer bearing surface 617 of flange 614 is configured to mate closely with the interior wall of uppermost inner tube section 210c and to slide relative thereto. Lower bearing surface 615 is configured to rest against the upper end of the sponge liner 240 (or uppermost sponge liner 240, if more than one). The upper bearing surface 616 of the flange 614 is configured to abut one or more shims 50 or, if no~~-shims~~ shims 50 are present, to abut a shoulder 211c formed in the wall of the uppermost inner tube section 210c, as will be explained in greater detail below. It should be noted that, although referred to herein as being a part of the uppermost inner tube section 210c, a portion of the upper end 214c of the uppermost inner tube section 210c is commonly referred to as an upper connector sub and is a separately attached section, the shoulder 211c being provided by a lower end of the upper connector sub. Again, however, the specific configuration of the inner barrel assembly and the particular terminology attached to the various features of the inner barrel assembly are immaterial to the present invention, and those of ordinary skill in the art will understand that the various aspects of the present invention are applicable to any core barrel configuration, regardless of the particular

structure and the terminology used to describe such structure.

Please amend paragraph number **[0107]** as follows:

[0107] During differential thermal expansion, the sponge liner 240 (or uppermost sponge liner 240, if more than one) will push upwardly against the lower bearing surface 615 of the flange 614 at the lower end 613 of the adjusting sleeve 610, causing the adjusting sleeve 610 and attached pressure compensation mechanism 500 to move upwards longitudinally along longitudinal axis 12. Longitudinal movement of the adjusting sleeve 610 and attached pressure compensation mechanism 500 is guided, at the lower end 613 thereof, by the outer bearing surface 617 on the adjusting sleeve 610 and, at the upper end thereof, by the outer cylindrical surface 515 of cylindrical housing 510. The O-ring type seal 540 maintains the fluid seal between the uppermost inner tube section 210c and the cylindrical housing 510 during longitudinal movement thereof.

Please amend paragraph number **[0108]** as follows:

[0108] As the cylindrical housing 510 of pressure compensation mechanism 500 moves upwardly through the uppermost inner tube section 210c due to an upward force applied thereto by the adjusting sleeve 610 of ~~temperature~~ thermal compensation mechanism 600, the volume of chamber 205 within inner barrel assembly 200 will increase, the magnitude of the volume increase being a function of the differential thermal expansion of the uppermost inner tube section 210c relative to the sponge liner or liners 240 disposed therein. This increase in volume of the chamber 205 will "absorb" at least a portion of the expanded volume of the presaturation fluid, which, as noted above, also thermally expands as a result of the relatively high downhole temperature. Therefore, the thermal compensation mechanism 600 performs a pressure compensation function in that thermal compensation mechanism 600 may expand the volume of chamber 205 available to contain presaturation fluid, thereby lowering the presaturation fluid pressure. Thus, pressure compensation mechanism 500 and thermal compensation mechanism 600 cooperate to maintain the presaturation fluid pressure at or below a specified threshold value.

Please amend paragraph number **[0110]** as follows:

[0110] With reference to FIGS. 1A-1C and 9, the first embodiment of a valve assembly 700 includes a lower seal assembly 720 secured, for example, by threads, to the upper end 214a of the lowermost inner tube section 210a. The first valve assembly 700 further includes an upper seal assembly 740 secured, as by threads, to the lower end 212b of the intermediate inner tube section 210b. After presaturation of the individual inner tube sections 210a, 210b, 210c and make up of the inner barrel assembly 200, as will be described in greater detail below, the lower seal assembly 720 is secured to the upper seal assembly 740. The lower seal assembly 720 includes a housing 722 and a sealing element 724 secured therein. The sealing element 724 may comprise a generally planar diaphragm 725, as shown in ~~FIGS. 1A-1C and 9.~~ FIG. 9. Similarly, the upper seal assembly 740 includes a housing 742 and a sealing element 744 secured therein. The sealing element 744 may comprise a ball valve 745~~, as shown in FIGS. 1A-1C and 9~~. When the lower and upper seal assemblies 720, 740 are interconnected, a

chamber 705 is formed between the sealing element 724 of the lower seal assembly 720 and the sealing element 744 of the upper seal assembly 740.

Please amend paragraph number **[0112]** as follows:

[0112] Referring to FIGS. ~~1A-1C~~ 1A through 1C and 10, the second embodiment of a valve assembly 800 includes a lower seal assembly 820 secured, for example, by threads, to the upper end 214b of the intermediate inner tube section 210b. The second valve assembly 800 further includes an upper seal assembly 840 secured, as by threads, to the lower end 212c of the uppermost inner tube section 210c. After presaturation of the individual inner tube sections 210a, 210b, 210c and make up of the inner barrel assembly 200, the lower seal assembly 820 is secured to the upper seal assembly 840. The lower seal assembly 820 includes a housing 822 and a sealing element 824 secured therein. The sealing element 824 may comprise a dome-shaped diaphragm 825, as shown in ~~FIGS. 1A-1C and 10.~~ FIG. 10. Similarly, the upper seal assembly 840 includes a housing 842 and a sealing element 844 secured therein. The sealing element 844 may comprise another dome-shaped diaphragm 845~~, as shown in FIGS. 1A-1C and 10~~. When the lower and upper seal assemblies 820, 840 are interconnected, a chamber 805 is formed between the sealing element 824 of the lower seal assembly 820 and the sealing element 844 of the upper seal assembly 840.

Please amend paragraph number **[0113]** as follows:

[0113] In a further alternative embodiment, as shown in FIG. 11, a valve assembly 900 comprises a lower seal assembly 920 and an upper seal assembly 940. The lower seal assembly 920 is secured to, for example, the upper end 214a of the lowermost inner tube section 210a, and the upper seal assembly 940 is secured to the lower end 212b of the intermediate inner tube section 210b. After presaturation of the individual inner tube sections 210a, 210b, 210c and make up of the inner barrel assembly 200, the lower seal assembly 920 is secured to the upper seal assembly 940. The lower seal assembly 920 comprises a housing 922 and a sealing element 924 retained therein. In this embodiment, sealing element 924 comprises a releasable piston 925 held in place by a retaining element 960.

Retaining element 960 may comprise a threaded bolt impinging against the outer cylindrical surface of the releasable piston 925, as shown in FIG. 11, or any other suitable device known in the art, such as a clamp or a retaining pin. The releasable piston 925 is ~~configured—as by, for example, appropriate dimensioning or by the inclusion of an O-ring type seal (not shown)—~~ to provide a fluid seal between the outer cylindrical surface of the releasable piston 925 and the interior wall of the lower seal assembly housing 922 configured as by, for example, appropriate dimensioning or by the inclusion of an O-ring type seal (not shown). When the piston is released via actuation of the retaining element 960, the releasable piston 925 is free-floating within the inner barrel assembly 200. The upper seal assembly 940 comprises a housing 942 and a sealing element 944 secured therein, the sealing element 944 comprising a generally planar diaphragm 945. When the lower and upper seal assemblies 920, 940 are interconnected, a chamber 905 is formed between the sealing element 924 of lower seal assembly 920 and the sealing element 944 of the upper seal assembly 940.

Please amend paragraph number **[0114]** as follows:

[0114] The diaphragm 725 of the valve assembly 700, the dome-shaped diaphragms 825, 845 of the valve assembly 800, and the planar diaphragm 945 of the valve assembly 900 may be constructed of any suitable material as known in the art, so long as the diaphragms 725, 825, 845, 945 fail, or rupture, upon application of the appropriate load or fluid pressure, as will be explained below. The diaphragms 725, 825, 845, 945 may be secured within their respective housings 722, 822, 842, 942 by any suitable method known in the art. For example, the diaphragms 725, 825, 845, 945 may be adhesively bonded ~~to—or,~~ to or, alternatively, molded ~~into—~~ into, annular grooves 726, 826, 846, 946 in the housings 722, 822, 842, 942, respectively.

Please amend paragraph number **[0115]** as follows:

[0115] In the assembled inner barrel assembly ~~200—~~ 200 — comprising lowermost inner tube section 210a, intermediate inner tube section 210b, and uppermost inner tube section ~~201c—~~ 201c — the valve assemblies 700, 800, 900 provide fluid seals between successive inner

barrel sections. Accordingly, the lowermost inner tube section 210a, having piston assembly 400 at its lower end 212a and lower seal assembly 720 of valve assembly 700 (or lower seal assembly 920 of valve assembly 900) at its upper end 214a, forms a sealed chamber 216a that may individually be filled with presaturation fluid. Similarly, the intermediate inner tube section 210b, having upper seal assembly 740 of valve assembly 700 (or upper seal assembly 940 of valve assembly 900) at its lower end 212b and lower seal assembly 820 of valve assembly 800 at its upper end 214b, forms a sealed chamber 216b, and the uppermost inner tube section 210c, having upper seal assembly 840 of valve assembly 800 at its lower end 212c and pressure compensation mechanism 500 at its upper end 214c, forms a sealed chamber 216c, each of which may individually be filled with presaturation fluid. Thus, the inner tube sections 210a, 210b, 210c may be individually presaturated and then subsequently interconnected to form inner barrel assembly 200.

Please amend paragraph number **[0118]** as follows:

[0118] Referring to FIG. 10, the valve assembly 800, having a lower seal assembly 820 including a sealing element 824 comprised of a dome-shaped diaphragm 825 and an upper seal assembly 840 including a sealing element 844 comprised of a dome-shaped diaphragm 845, may be opened by rupturing both dome-shaped diaphragms 825, 845. The dome-shaped diaphragms 825, 845 are configured such that, upon interconnection of the lower and upper seal assemblies 820, 840, an upwardly extending curved surface 827 of the <u>dome-shaped</u> diaphragm 825 will impinge against a downwardly extending curved surface 847 of the <u>dome-shaped</u> diaphragm 845. The <u>dome-shaped</u> diaphragms 825, 845 are configured such that the forces exerted on the <u>dome-shaped</u> diaphragms 825, 845 as a result of the mutual engagement of curved surfaces 827, 847 are sufficient to rupture both <u>dome-shaped</u> diaphragms 825, 845. Also, rupturing of the <u>dome-shaped</u> diaphragms 825, 845 may be facilitated by compression of fluid within chamber 805 upon interconnection of the lower and upper seal assemblies 820, 840. Further, the valve assembly 800 may include a tap <u>751</u> (see FIG. 9) for introducing a volume of presaturation fluid into the chamber 805 to create a fluid pressure within chamber 805 sufficient to burst the <u>dome-shaped</u> diaphragms 825, 845, either alone or in combination with contact between the curved surfaces 827, 847 of the <u>dome-shaped</u> diaphragms 825, 845, respectively.

Please amend paragraph number **[0119]** as follows:

[0119] Referring to FIG. 11, the valve assembly 900, having a lower seal assembly 920 including a sealing element 924 comprised of a releasable piston 925 and an upper seal assembly 940 including a sealing element 944 comprised of a generally planar diaphragm 945, may be opened by rupturing the planar diaphragm 945 and subsequently releasing the releasable piston ~~925,~~ 925; the releasable piston 925 then being free-floating within the inner barrel assembly 200. The planar diaphragm 945 may be ruptured by compression of fluid within chamber 905 upon interconnection of the lower and upper seal assemblies 920, 940. Alternatively, the valve assembly 900 may include a tap (see FIG. 9) for introducing a volume of presaturation fluid into the chamber 905 to create a fluid pressure within chamber 905 sufficient to burst the ~~diaphragm~~ releasable piston 925.

Please amend paragraph number **[0121]** as follows:

[0121] Although the exemplary embodiments of the present invention, as illustrated in FIGS. 1A-1C, 7, 8, 9, 10, and 11, show three interconnected inner tube sections 210a, 210b, 210c separated by valve assemblies 700 (or 900), 800, those of ordinary skill in the art will appreciate that any suitable number and combination of inner tube sections 210a, 210b, 210c and valve assemblies 700, 800, 900 according to the present invention may be employed to perform sponge coring operations. For example, two inner tube sections separated by one valve assembly 700, 800, 900 may be used. Alternatively, four inner tube sections may be employed separated from one another by valve assemblies 700, 800, 900.

Please amend paragraph number **[0124]** as follows:

[0124] In another embodiment, as shown in FIGS. 12A-12C, the inner tube sections 210a, 210b, 210c are directly interconnected, and no valve assemblies 700, 800, 900 are used. In this embodiment, the upper end 214a of the lowermost inner tube section 210a is directly ~~secured~~ secured, as by threads, for ~~example~~ example, to the lower end 212b of the intermediate inner tube section 210b. Similarly, the upper end 214b of the intermediate inner

tube section 210b is directly secured to the lower end 212c of the uppermost inner tube section 210c. Thus, the fluid chambers 216a, 216b, 216c of the inner tube sections 210a, 210b, 210c, respectively, are interconnected to form a single, continuous fluid chamber 205 for receiving presaturation fluid.

Please amend paragraph number **[0126]** as follows:

[0126] The inner barrel assembly 200 of FIGS. 12A-12C can be assembled on the rig floor and subsequently evacuated and filled with presaturation fluid. Prior to insertion into the outer barrel assembly 100, the inner barrel assembly 200 may be temporarily stored in a mouse hole and, alternatively, presaturation of the inner barrel assembly 200 may occur while the inner barrel assembly 200 is located in the mouse hole. The piston assembly 400 provides a fluid seal at a lower end of the fluid chamber 205, and the pressure compensation mechanism 500 provides a fluid seal at an upper end of the chamber 205. The entire presaturated inner barrel assembly~~ 200 having~~ 200 (having the single, continuous fluid chamber 205 filled with presaturation~~ fluid~~ fluid) can then be disposed in the outer barrel assembly 100. The introduction of presaturation fluid into the inner barrel assembly 200 shown in FIGS. 12A-12C may also occur after the inner barrel assembly 200 is disposed in the outer barrel assembly 100.

Please amend paragraph number **[0127]** as follows:

[0127] For either of the core barrel assemblies shown and described with respect to FIGS. 1A-1C and 12A-12C, respectively, friction between the sponge-lined inner barrel assembly 200 and the core sample 5 may be significantly reduced by using one or more sponge liners~~ 240~~ 240 or, optionally, one or more integrated sponge barrels~~ 280~~ 280, according to the invention. Specifically (see FIG. 2), a layer of webbing material 246 may be molded into or immersed within the annular sponge layer 241 of the sponge liner or liners 240, or a layer of webbing material 286 may be molded into or immersed within the sponge material 281 of the integrated sponge barrel or barrels 280. Reducing friction between the core sample 5 and inner barrel assembly 200 can protect against fracture of the core sample 5, thereby improving core integrity, especially for an extended-length inner barrel assembly 200 (i.e., one having a length

greater than the conventional 30 feet).

Please amend paragraph number **[0128]** as follows:

[0128] In a further embodiment of the present invention, the sponge core barrel assembly 10 includes a swivel assembly disposed proximate the core bit. Conventionally, the swivel assembly in a core barrel is disposed proximate the upper end of the outer barrel assembly and the upper end of the inner barrel assembly is secured to the swivel assembly such that the inner barrel assembly is suspended therefrom within the outer barrel assembly. The swivel assembly, therefore, supports the inner barrel assembly within the outer barrel assembly~~-and-~~ and — through the action of one or more~~-bearings-~~ bearings — enables the outer barrel assembly to rotate freely relative to the inner barrel assembly. If differential thermal expansion exists between the inner and outer bearing assemblies, the lower end of the inner barrel assembly (i.e., the core shoe) expands towards, or away from, the lower end of the outer barrel assembly (i.e., the bit body) longitudinally along the longitudinal axis 12 of the core barrel. Such differential thermal expansion may result in mechanical damage to components of a core barrel or lead to increased flow split, as noted above. The present invention solves this problem by positioning a swivel assembly proximate the core~~-bit—i.e.,~~ bit (i.e., a “near-bit” swivel~~-assembly-~~ assembly) and allowing the inner barrel assembly to thermally expand longitudinally upwards therefrom unimpeded. Employing a near-bit swivel assembly according to the present invention eliminates the conventional swivel assembly secured to the upper end of the inner barrel assembly and located proximate the upper end of the outer barrel assembly, thereby enabling the upper end of the inner barrel assembly to move freely within the outer barrel assembly.

Please amend paragraph number **[0132]** as follows:

[0132] Although the radial and thrust bearing assemblies 1020, 1040 shown and described herein are of the sliding- or journal-type, those of ordinary skill in the art will understand that the radial and thrust bearing assemblies 1020, 1040 may be configured as any suitable type of bearing known in the art. For example, one or both of the radial and thrust bearing assemblies 1020, 1040 may be configured as a roller-type bearing. Also, a single bearing

assembly providing both radial and longitudinal support may be used in lieu of the separate radial and thrust bearing assemblies 1020, 1040. Further, a near-bit swivel assembly 1000 (or the sponge core barrel assembly 10 generally) may include other bearing assemblies in addition to the radial and thrust bearing assemblies 1020, 1040 of the near-bit swivel assembly 1000 described herein. By way of example, one or more radial bearing assemblies may be disposed along the length of the inner barrel assembly 200 to provide further radial support therefor, so long as the additional bearing assemblies do not interfere with differential thermal expansion between the inner barrel assembly 200 and the outer barrel assembly 100.

Please amend paragraph number **[0133]** as follows:

[0133] An opposing lower surface 1048 of the thrust plate 1042 rests against a shoulder 340a provided on the interior wall of the core bit 300a to maintain the lower end of the inner barrel assembly 200 (i.e., the core shoe 220) at a desired longitudinal distance from the throat 320a of the core bit 300a. Also disposed on the interior wall of the core bit 300a are one or more latch mechanisms 350a. A latch mechanism 350a is configured to allow passage thereby of the core shoe 220 and the lower end 212a of the lowermost inner tube section 210a during insertion of the inner barrel assembly 200 into the outer barrel assembly 100, and is further ~~configured -~~ configured — in conjunction with the shoulder ~~340a -~~ 340a — to maintain the inner barrel assembly 200 in the proper longitudinal position within the outer barrel assembly 100. The latch ~~element~~ mechanism 350a may be any suitable latching or locking mechanism known in the art capable of retaining the inner barrel assembly 200 in the proper longitudinal position.

Please amend paragraph number **[0134]** as follows:

[0134] By way of example, the latch mechanism 350a may comprise a retractable latch 390, as shown in FIG. 13. The retractable latch 390 includes a pawl 395 resiliently biased radially inward toward the longitudinal axis 12 and configured to retract within a cavity 393 in the interior wall of the core bit 300a during passage thereby of the core shoe 220 and the lower end 212a of the lowermost inner tube section 210a. The retractable latch 390 further includes at least one register surface 397 configured to contact, or at least lie in close proximity to, an

opposing upper surface 1049 of the bearing plate 1044. When the inner barrel assembly 200 is fully inserted into the outer barrel assembly 100 and the lower surface 1048 of the thrust plate 1042 is abutting the shoulder 340a on the interior wall of the core bit 300a, the register surface 397 of the retractable latch 390 maintains the lower surface 1048 of the thrust plate 1042 in contact with, or at least in close proximity to, the shoulder 340a. Thus, the shoulder 340a, thrust bearing assembly 1040, and retractable latch ~~390~~ 390, as well as any latch mechanism ~~350a~~ 350a, are cooperatively configured to maintain the inner barrel assembly 200 in a fixed vertical position relative to the outer barrel assembly 100 during coring.

Please amend paragraph number **[0136]** as follows:

[0136] The scope of the present invention also encompasses methods of performing sponge coring. Such a method may begin with assembly of the outer barrel assembly 100. A suitable-length outer barrel assembly 100 having a core bit 300 secured to a lower end thereof is rigged up and is suspended from the rig floor, either above or within the bore hole. The outer barrel assembly 100 may also include any one of a number of conventional core barrel components as is necessary, including a safety joint, one or more subs having a plurality of core barrel stabilizers, one or more outer tube subs having a plurality of wear ribs, or a drop ball and corresponding pressure relief plug.

Please amend paragraph number **[0138]** as follows:

[0138] One or more sponge liners 240 are then disposed within the lowermost inner tube section 210a. A single sponge liner 240 substantially equivalent in length to the length of the lowermost inner tube section ~~210a~~ 210a — which may be ~~30 ft, 45 ft, 60 ft,~~ 30 feet, 45 feet, 60 feet, or any other suitable ~~length~~ length — or, alternatively, a plurality of sponge liners 240 may be disposed within the lowermost inner tube section 210a and stacked end-to-end to fill substantially the entire length of the lowermost inner tube section 210a.

Please amend paragraph number **[0142]** as follows:

[0142] Make up of the intermediate inner tube section 210b includes securing, as by

threads, the upper seal assembly 740 of the valve assembly 700 (or the upper seal assembly 940 of the valve assembly 900) to the lower end 212b of the intermediate inner tube section 210b. The upper seal assembly 740 includes a sealing element 744, which may comprise a ball valve 745, as shown in ~~FIGS. 1A-1C and 9,~~ FIG. 9, a generally planar diaphragm, a dome-shaped diaphragm, a releasable piston, or any other suitable sealing element as known in the art.

Please amend paragraph number **[0143]** as follows:

[0143] One or more sponge liners 240 are then disposed within the intermediate inner tube section 210b. A single sponge liner 240 substantially equivalent in length to the length of the intermediate inner tube section ~~210b -~~ 210b — which, again, may be ~~30 ft, 45 ft, 60 ft,~~ 30 feet, 45 feet, 60 feet, or any other suitable ~~length -~~ length — or, alternatively, a plurality of sponge liners 240 may be disposed within the intermediate inner tube section 210b and stacked end-to-end to fill substantially the entire length of the intermediate inner tube section 210b.

Please amend paragraph number **[0146]** as follows:

[0146] The lower seal assembly 820 of the valve assembly 800 is then secured, as by threads, to the upper end 214b of the intermediate inner tube section 210b. The lower seal assembly 820 includes a sealing element 824, which may comprise a dome-shaped diaphragm 825, as shown in ~~FIGS. 1A-1C and 10,~~ FIG. 10, a generally planar diaphragm, a ball valve, a releasable piston, or any other suitable sealing element as known in the art. Thus, a sealed chamber 216b is created within the intermediate inner tube section 210b, the upper seal assembly 740 of valve assembly 700 (or upper seal assembly 940 of valve assembly 900) forming a fluid seal proximate its lower end 212b and the lower seal assembly 820 of valve assembly 800 forming a fluid seal proximate its upper end 214b. Presaturation fluid may then be introduced into the chamber 216b to protect the sponge liner or liners 240.

Please amend paragraph number **[0147]** as follows:

[0147] Make up of the uppermost inner tube section 210c includes securing, as by threads, the upper seal assembly 840 of the valve assembly 800 to the lower end 212c of the

uppermost inner tube section 210c. The upper seal assembly 840 includes a sealing element 844, which may comprise a dome-shaped diaphragm 845, as shown in ~~FIGS. 1A-1C and 10,~~ FIG. 10, a generally planar diaphragm, a ball valve, a releasable piston, or any other suitable sealing element as known in the art.

Please amend paragraph number **[0151]** as follows:

[0151] It should be noted that make up of the uppermost inner tube section 210c, especially insertion of the adjusting sleeve 610 and shims 50, may be facilitated by a connection joint proximate the upper end 214c of the uppermost inner tube section 210c. A portion of the upper end 214c of the uppermost inner tube section 210c may then be a separately attached tube section, the lower end 212c of which may provide the shoulder 211c. Although considered herein as simply a portion of the uppermost inner tube section 210c, this separately attached tube section is, as was suggested above, commonly referred to as an upper connector sub.

Please amend paragraph number **[0153]** as follows:

[0153] In an alternative embodiment, the uppermost inner tube section 210c and the sleeve 242 of the sponge liner or liners 240 disposed therein are constructed of the same material or of materials exhibiting similar rates of thermal expansion. Differential thermal expansion between the uppermost inner tube section 210c and the sponge liner or liners 240 is, therefore, eliminated or substantially reduced. In this embodiment, thermal compensation mechanism 600 with adjusting sleeve 610 is no longer necessary. Any gap 250c existing between the top end of the sponge liner 240 (or the top end of the uppermost sponge liner 240, if more than one) and the shoulder 211c extending from the interior wall of the uppermost inner tube section 210c is simply filled with the appropriate number of shims 50. The cylindrical housing 510 of pressure compensation mechanism 500 can be secured in the upper end 214c of the uppermost inner tube section 210c using a threaded connection, a retaining bolt, a retaining pin, a clamp, or any other suitable connecting element or method as known in the art.

Please amend paragraph number **[0157]** as follows:

[0157] If a releasable piston 925 and a generally planar diaphragm 945 are utilized in the lower and upper seal assemblies 920, 940 (see FIG. 11), respectively, actuation of the valve assembly 900 comprises rupturing of the planar diaphragm 945 followed by release of the releasable piston 925. The planar diaphragm 945 may be ruptured by the compression of fluid within the chamber 905 formed between the sealing elements 924, 944 during interconnection of the lower and upper seal assemblies 920, 940, by introducing presaturation fluid through a tap into the chamber 905 to burst the planar diaphragm 945, or by a combination thereof. The releasable piston 925 may be released by operation of the retaining element 960.

Please amend paragraph number **[0159]** as follows:

[0159] The valve assembly 800 is then actuated to join the chamber 216c within uppermost inner tube section 210c with the chambers 216a, 216b of the lowermost and intermediate inner tube sections 210a, 210b, respectively, which are already in fluid communication. Actuation of the valve assembly 800 requires rupturing of the dome-shaped diaphragms 825, 845 comprising sealing elements 824, 844 of the lower and upper seal assemblies 820, 840, respectively. Again, rupturing of the dome-shaped diaphragms 825, 845 may be performed by forces generated when the diaphragms come into mutual contact, by introducing presaturation fluid through a tap into the chamber 805 formed between the sealing elements 824, 844 to burst the dome-shaped diaphragms 825, 845, by compression of fluid within the chamber 805 during interconnection of the lower and upper seal assemblies 820, 840, or by a combination thereof.

Please amend paragraph number **[0160]** as follows:

[0160] The lowermost inner tube section 210a, the intermediate inner tube section 210b, and the uppermost inner tube section 210c are then lowered into the outer barrel assembly 100. The upper end 214c of the uppermost inner tube section 210c may be secured to the inner barrel assembly ~~100~~ 200 by a conventional swivel assembly, suspending the interconnected inner tube sections 210a, 210b, 210c within the outer barrel assembly 100 and enabling the outer barrel assembly 100 to rotate freely relative to the inner tube

sections 210a, 210b, 210c. The upper end 120 of the outer barrel assembly 100 can then be secured to a drill string for coring.

Please amend paragraph number **[0161]** as follows:

[0161] In an alternative embodiment, make up of the sponge core barrel assembly 10 proceeds as just described; however, the sleeves 242 of the sponge liner or liners 240 disposed within each inner tube section 210a, 210b, 210c are constructed of a material that is the same as, or exhibits similar thermal expansion characteristics as, the inner tube ~~section~~ <u>sections</u> 210a, 210b, 210c. In another alternative embodiment according to the invention, make up of the sponge core barrel assembly 10 proceeds as described above but, rather than employing separate sponge liners 240 and inner tube sections 210a, 210b, 210c, one or more integrated sponge barrels 280 comprise the inner barrel assembly 200. In either of the above-described ~~embodiments - i.e., use of sleeves 242 and inner tube sections 210a, 210b, 210c constructed of the same or similar materials or use of integrated sponge barrels 280 -~~ <u>embodiments,</u> differential thermal expansion between the inner tube sections 210a, 210b, 210c and the sponge liner or liners 240 disposed therein, respectfully, is substantially eliminated, and the thermal compensation mechanism 600 is no longer necessary. Accordingly, the pressure compensation mechanism 500 can be disposed directly in the upper end 214c of the uppermost inner tube section 210c and rigidly secured thereto by, for example, threads.

Please amend paragraph number **[0163]** as follows:

[0163] Referring again to FIGS. 12A-12C, make up of the inner barrel assembly 200 may include disposing a piston assembly 400 proximate the lower end 212a of the lowermost inner tube section 210a and disposing a pressure compensation mechanism ~~500 -~~ <u>500 —</u> and, if differential thermal expansion will occur, a thermal compensation mechanism ~~600 -~~ <u>600 —</u> proximate the upper end 214c of the uppermost inner tube section 210c. Each of the inner tube sections 210a, 210b, 210c has one or more sponge liners 240 disposed therein, and shims 50 may be provided in the gaps 250a, 250b, 250c, respectively, as noted above. The sleeve 242 of the sponge liner or liners 240 disposed in each of the inner tube sections 210a, 210b, 210c and the

inner tube sections 210a, 210b, 210c themselves may be constructed of materials exhibiting similar rates of thermal expansion or the same material. Alternatively, the inner tube sections 210a, 210b, 210c of FIGS. 12A-12C may comprise integrated sponge barrels 280 (see FIG. 5).

Please amend paragraph number **[0168]** as follows:

[0168] The near-bit swivel assembly 1000 supports the inner barrel assembly ~~200~~ 200, both longitudinally and ~~radially~~ radially, within and relative to the outer barrel assembly 100, while enabling the outer barrel assembly 100 to rotate freely with respect to the inner barrel assembly 200 disposed therewithin. Further, the near-bit swivel assembly 1000 maintains the core shoe 220 and the lower end 212a of the lowermost inner tube section 210a at the correct vertical position above the throat 320a of the core bit 300a while, simultaneously, allowing the upper end of the inner barrel assembly 200 (upper end 214c of uppermost inner tube section 210c) to freely thermally expand within the outer barrel assembly 100.

Please amend paragraph number **[0170]** as follows:

[0170] As noted above, the temperature at the bottom of the bore hole may be significantly higher than the ambient temperature at the surface where the inner barrel assembly 200 is made up. Thus, as the sponge core barrel assembly 10 descends into the bore hole, the inner and outer barrel assemblies 200, 100, as well as the presaturation fluid contained within the chamber 205, will expand due to the temperature increase. As a result, differential thermal expansion may occur within the inner barrel assembly 200 due to differences in thermal properties of the materials used to construct the various components of the inner barrel assembly 200. Also, thermal expansion of the presaturation fluid within chamber 205 may, if uncompensated for, cause the fluid pressure therein to increase significantly. Further, heat generated during the coring operation itself may lead to additional thermal expansion of the inner barrel assembly 200 and the presaturation fluid contained therein.

Please amend paragraph number **[0175]** as follows:

[0175] Additional pressure compensation is provided by the pressure compensation mechanism 500. The pressure relief element 520 or any other suitable pressure relief mechanism disposed in the cylindrical housing 510 of the pressure compensation mechanism 500 is configured to open when the fluid pressure within chamber 205 exceeds a selected threshold value and, subsequently, to close when the threshold pressure is restored. As the presaturation fluid thermally expands, the pressure compensation mechanism 500 continually maintains the fluid pressure within chamber 205 at or below the selected threshold pressure. Therefore, the pressure compensation mechanism 500 and the thermal compensation mechanism 600 cooperatively function together to maintain the presaturation fluid within chamber 205 at or below the threshold pressure and, hence, provide a pressure compensated inner barrel assembly 200.

Please amend paragraph number **[0179]** as follows:

[0179] A core sample 5 having a length substantially equal to the sum of the lengths of the inner tube sections 210a, 210b, 210c, as well as having high structural integrity, can then be cut. Tripping of the drill string from the bore hole will not be necessary prior to cutting the entire length of the core sample 5, which core sample length may comprise ~~45 feet, 60 feet, 90 feet,~~ 45-ft, 60-ft, 90-ft, or a longer length, as desired. When coring is complete, the sponge core barrel assembly 10 can be tripped from the bore hole, the inner barrel assembly 200 removed from the outer barrel assembly 100, and the core sample 5 removed therefrom. The core sample 5 may be retained in the sponge liner or liners 240 for shipment and subsequent analysis and, if integrated sponge barrels 280 are employed, the core sample 5 may be contained directly in the integrated sponge barrels 280 for transportation. If a webbing layer 246, 286 is provided in the annular sponge ~~layer~~ layers 241, 281, friction between the core sample 5 and annular sponge ~~material~~ layers 241, 281 can be significantly reduced and core integrity preserved.

Please amend paragraph number **[0180]** as follows:

[0180] In a further alternative embodiment of the present invention, coring operations are performed using a sponge core barrel assembly 10 including a near-bit swivel assembly 1000.

Coring with a sponge core barrel assembly ~~10~~ 10, including the near-bit swivel ~~assembly~~ assembly 1000, proceeds as described above; however, the lower end of the inner barrel assembly 200 (lower end 212a of lowermost inner tube section 210a) is supported by the near-bit swivel assembly 1000 and the upper end of the inner barrel assembly 200 (upper end 214c of uppermost inner tube section 210c) is allowed to freely thermally expand upwards within the outer barrel assembly 100, thereby compensating for differential thermal expansion between the inner barrel assembly 200 and the outer barrel assembly 100. Coring with a near-bit swivel assembly 1000 may be desirable when the inner tube sections 210a, 210b, ~~210c –~~ 210c — or, alternatively, the integrated sponge barrels ~~280 –~~ 280 — comprising the inner barrel assembly 200 are comprised of aluminum, which thermally expands at approximately twice the rate of steel, which is the material typically used to construct the outer barrel assembly 100.